

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Venkat Selvamanickam, et al.

Title: METALORGANIC CHEMICAL VAPOR DEPOSITION (MOCVD)
PROCESS AND APPARATUS TO PRODUCE MULTI-LAYER HIGH-
TEMPERATURE SUPERCONDUCTING (HTS) COATED TAPE

App. No.: 10/602,468 Filed: June 23, 2003

Examiner: Aaron Austin Group Art Unit: 1775

Customer No.: 34456 Confirmation No.: 2661

Atty. Dkt. No.: 1014-SP156-US

Mail Stop Appeal Brief - Patents
The Board of Patent Appeal and Interferences
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

BRIEF ON APPEAL

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This brief contains these items under the following headings, and in the order set forth below (37 C.F.R. § 41.37(c)(1)):

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The final page of this brief before the beginning of the Appendix of Claims bears the representative's signature.

I. REAL PARTY IN INTEREST (37 C.F.R. § 41.37(c)(1)(i))

Assignments from each of the inventors to the sole assignee, SuperPower, Inc., of 450 Duane Avenue, Schenectady, NY 12304, were recorded by the United States Patent and Trademark Office (USPTO) on June 30, 2003, at Reel/Frame: 014241/0040. The real party of interest is SuperPower, Inc.

II. RELATED APPEALS AND INTERFERENCES (37 C.F.R. § 41.37(c)(1)(ii))

Appellants, Appellants' legal representatives, and Assignee know of no related appeals or interferences which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS (37 C.F.R. § 41.37(c)(1)(iii))

Claims 23-34 and 36-43, all of which are rejected and remain pending herein. Claims 1-22 and 35 were canceled. Each of claims 23-34 and 36-43 is hereby appealed by Appellants.

IV. STATUS OF AMENDMENTS (37 C.F.R. § 41.37(c)(1)(iv))

No amendment was filed or entered after the Final Office Action.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER (37 C.F.R. § 41.37(c)(1)(v))

A concise explanation of the subject matter defined in each of the independent claims involved in the appeal is provided below.

A. Claim 23

Claim 23 is reproduced below for clarity.

23. A superconductive article comprising:
 a substrate tape; and
 a superconductive layer, wherein the superconductive layer comprises a plurality of
 individually identifiable superconductive films of the same material, the plurality
 of individually identifiable superconductive films (i) comprising at least 3
 superconductive films, and (ii) being disposed one atop another, atomically
 bonded to each other, and free of intervening bonding layers between
 superconductive films.

As supported in the specification, a superconductive article includes a substrate tape and a superconductive layer. The superconductive layer includes a plurality of superconductive films of the same material. The plurality of superconductive films includes at least three superconductive films being disposed one atop another and free of intervening bonding layers between superconductive layers (see Fig. 4a and paragraph [0066] of the Present Application). Additionally, the plurality of superconductive films are individually identifiable and atomically bonded to each other (see paragraphs [0071]-[0073] of the Present Application and the Declarations by Dr. Venkat Selvamanickam).

B. Claim 43

Claim 43 is reproduced below for clarity.

43. A superconducting article comprising:
 a metal substrate tape containing a previously deposited buffer layer; and
 a superconductive layer, wherein the superconductive layer (i) comprises at least first,
 second and third individually identifiable superconductive films of the same high-
 temperature superconductive material, the first and second, and the second and
 third superconductive films being disposed one atop another , atomically bonded
 to each other, and free of intervening bonding layers between superconductive
 films, and
 (ii) has a thickness of greater than 2 microns.

As supported in the specification, a superconductive article includes a substrate tape and a superconductive layer. The superconductive layer includes a plurality of superconductive films of the same material and has a thickness of greater than 2 microns. The plurality of superconductive films includes at least three superconductive films being disposed one atop another and free of intervening bonding layers between the superconductive layers (see Fig. 4a and paragraphs [0066] and [0028] of the Present Application). Additionally, the superconductive films are individually identifiable and atomically bonded to each other (see paragraphs [0071]-[0073] of the Present Application and the Declarations by Dr. Venkat Selvamanickam).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL (37 C.F.R. § 41.37(c)(1)(vi))

A. Appellants respectfully request review of the rejection of claims 23-34 and 36-43 under 35 U.S.C. § 103(a) over US Pub. 2005/0173679 (hereinafter “Mannhart”).

VII. ARGUMENTS (37 C.F.R. § 41.37(c)(1)(vii))

A. Claims 23-34 and 36-43 would not have been obvious under 35 U.S.C. § 103(a) over Mannhart.

The USPTO has the burden of establishing a *prima facie* case of obviousness, which requires the prior art references must teach each and every claim limitation. See generally, MPEP §§ 2142 and 2143. In particular, to establish a *prima facie* case of obviousness of the claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). Moreover, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *KSR Int'l v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007). More particularly, the USPTO must articulate (1) a finding that there was some teaching, suggestion, or motivation to modify the references or to combine reference teachings and (2) a finding that there was reasonable expectation of success.

“Examination Guidelines for Determining Obviousness Under 35 U.S.C. 103 in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*,” 75 F.R. 57534 (2007) (hereinafter “Examination Guidelines”). As will be discussed in more detail below, the USPTO has failed to provide a proper teaching, suggestion, or motivation to achieve a superconductive layer comprising at least 3 individually identifiable superconductive films of the same material being atomically bonded to each other and free of intervening bonding layers between the superconductive films. Therefore, the USPTO has failed to establish a *prima facie* case of obviousness.

The presently claimed invention is directed to a superconductive article comprising a substrate tape and a superconductive layer. The superconductive layer includes at least three individually identifiable superconductive films of the same material disposed one atop another. Furthermore, the superconductive films are atomically bonded to each other and free of intervening bonding layers between the superconductive films. That the films are individually identifiable and atomically bonded is an inherent result of the particular multi-zone metal organic chemical vapor deposition (MOCVD) process discovered by Appellants, as discussed in the Declarations of Dr. Venkat Selvamanickam.

Turning to the cited prior art, Mannhart discloses bringing superconductive layers together to form a superconducting contact between the layers. Specifically, Mannhart teaches clamping two superconductive layers together using a mechanical joint. Two tapes, each including a metal substrate and a superconductive layer, are mounted together with their superconductive layers facing. The contact between the superconductive layers is established by mechanically fixing the tapes, such as by folding and pressing the substrates (Mannhart at Fig. 5 and paragraphs [0035] and [0041]-[0042]). As such, the superconductive layers are bonded together through mechanical rather than atomic forces.

The USPTO relies upon paragraph [0041] of Mannhart to allegedly suggest that the superconductive layers can be comprised of multiple superconductive layers. Specifically, in paragraph [0041], Mannhart states “like the buffer-layers, for the high-Tc

superconductors a variety of materials, or multilayers may be used.” References must be considered as a whole. Thus, upon reading the entire specification of Mannhart, one of ordinary skill in the art would have read paragraph [0041] in context of paragraph [0039]. In paragraph [0039], Mannhart describes the structure of the buffer layer consisting of various sublayers, such as $\text{CeO}_2/\text{YSZ}/\text{CeO}_2$. The sublayers of the buffer layer are not of the same material, but rather alternating layers of CeO_2 and YSZ (yttria stabilized zirconia). As a whole, Mannhart suggests that the superconductor layer could be formed using alternating layers of different compositions. Further, Mannhart provides no suggestion that these multilayers are of the same material and are atomically bonded to each other and free of intervening bonding layers between the superconductive layers. As such, Mannhart’s disclosure of multilayers is insufficient to teach, suggest, or provide proper motivation for a superconductive layer including a plurality of individually identifiable superconductive films of the same material being disposed one atop another, atomically bonded to each other, and free of intervening bonding layers between superconductive films.

Further, the USPTO suggests that the applied pressure of the mechanical bonding induces atomic bonding between the superconductive layers. The contact between the superconductive layers is established by mechanically fixing the tapes, such as by folding and pressing the substrates (Mannhart at Fig. 5 and paragraphs [0035] and [0041]-[0042]). While the close proximity of the two superconductive layers could result in Van der Waals interactions between the two layers, one of ordinary skill in the art would have understood that Van der Waals forces are weak compared to covalent bonds and ionic bonds. Van der Waals interactions are generally not strong enough to bond the superconductive layers together and removal of the mechanical forces holding the superconductive layers in contact would result in the separation of the layers. As such, the contact between the superconductive layers is the result of a mechanical force, rather than an atomic bond.

Still further, the USPTO apparently suggests that mere duplication of the superconductive layers would be obvious. However, it is not clear how one could simply

add a third superconductive layer in Fig. 5 of Mannhart, without damaging the existing layers or causing other undesired consequences. Placing a third superconductive layer in contact with either of the two superconductive layers as illustrated in Fig. 5 of Mannhart would require the removal of at least one substrate-buffer layer system. As the superconductive layers are only a few microns thick (Mannhart at paragraph [0010]), removal of the substrate and the buffer layer system would generally damage the existing superconductive layers. As such, one of ordinary skill in the art would not have a reasonable expectation of success in adding a third superconductive layer as claimed in accordance with the teachings of Mannhart.

In summary, Appellants submit that Mannhart fails to teach, suggest, or provide proper motivation for a superconductive layer comprising at least three superconductive films of the same material being disposed one atop another, atomically bonded to each other, and free of intervening bonding layers between superconductive films. As such, the USPTO has failed to establish a *prima facie* case of obviousness with respect to claims 23 and 43. Appellants respectfully submit that claims 23 and 43 are allowable. Claims 24-34 and 36-42 depend directly or indirectly from claim 23 and are allowable for at least the same reasons as claim 23. Therefore, Appellants respectfully request the Board to reverse the rejection of claims 23-34 and 36-42 for failure to establish a *prima facie* case of obviousness.

VIII. CONCLUSION

For at least the foregoing reasons, Appellants respectfully request the board to review and reverse the grounds for rejection subject to appeal.

Date

9/15/08

Respectfully submitted,



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IX. APPENDIX 1: CLAIMS INVOLVED IN THE APPEAL (37 C.F.R. § 41.37(c)(1)(viii))

The text of each claim involved in the appeal is as follows:

23. A superconductive article comprising:
a substrate tape; and
a superconductive layer, wherein the superconductive layer comprises a plurality of individually identifiable superconductive films of the same material, the plurality of individually identifiable superconductive films (i) comprising at least 3 superconductive films, and (ii) being disposed one atop another, atomically bonded to each other, and free of intervening bonding layers between superconductive films.
24. The superconductive article of claim 23, wherein the substrate tape comprises a metal.
25. The superconductive article of claim 23 wherein the substrate tape contains nickel.
26. The superconducting article of claim 25 wherein the substrate tape comprises stainless steel.
27. The superconducting article of claim 25 wherein the substrate tape comprises a nickel alloy.
28. The superconducting article of claim 23 wherein the substrate tape comprises a previously deposited buffer layer.
29. The superconducting article of claim 28 wherein the buffer layer has a bi-axial texture.

30. The superconducting article of claim 28 wherein the buffer layer comprises yttrium-stabilized zirconia (YSZ).

31. The superconducting article of claim 23 wherein the superconducting layer comprises a high-temperature superconductor.

32. The superconducting article of claim 31 wherein the high temperature superconductor layer comprises a rare earth oxide.

33. The superconducting article of claim 31 wherein the rare earth oxide comprises YBCO ($\text{YBa}_2\text{Cu}_3\text{O}_7$).

34. The superconducting article of claim 33 wherein the superconducting layer comprises Sm123 ($\text{SmBa}_2\text{Cu}_3\text{O}_7$).

36. The superconducting article of claim 23 wherein the superconducting layer comprises at least 4 superconductive films.

37. The superconducting article of claim 23 wherein at least two of the superconductive films in direct contact with each other have different thicknesses.

38. The superconducting article of claim 23 wherein the superconductive layer has a thickness greater than 1.5 microns.

39. The superconducting article of claim 38 wherein the superconducting layer has a thickness greater than about 2 microns.

40. The superconducting article of claim 23 wherein each of the plurality of superconductive films does not exceed a thickness of 1.5 microns.

41. The superconducting article of claim 23 wherein the superconducting article has a current capacity of at least 100A/cm width.

42. The superconducting article of claim 23 wherein the superconducting article has a current density capability of greater than 0.6 MA/cm^2 .

43. A superconducting article comprising:

a metal substrate tape containing a previously deposited buffer layer; and

a superconductive layer, wherein the superconductive layer (i) comprises at least first, second and third individually identifiable superconductive films of the same high-temperature superconductive material, the first and second, and the second and third superconductive films being disposed one atop another, atomically bonded to each other, and free of intervening bonding layers between superconductive films, and

(ii) has a thickness of greater than 2 microns.

X. EVIDENCE APPENDIX (37 C.F.R. § 41.37(c)(1)(ix))

A first declaration pursuant to 37 C.F.R. § 1.132 by Venkat Selvamanickam was filed February 21, 2006. A second declaration pursuant to 37 C.F.R. § 1.132 by Venkat Selvamanickam was filed August 7, 2007.

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PO Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 C.F.R. §1.132

Sir, I hereby declare and state:

1. I am a joint inventor of the subject matter presently claimed in the above-identified patent application.
2. I received my doctorate degree in Materials Engineering from the University of Houston in Houston, TX.
3. I have been employed by IGC/SuperPower, Inc. since 1994, wherein I have been mainly engaged in research and development of superconducting materials, superconducting conductors, and processes for forming same.
4. I have reviewed the Office Action dated October 18, 2005, including the positions taken by the PTO with respect to several prior art references. I have also particularly reviewed the subject matter of US 5,106,828, Bhargava et al. (Bhargava). For the reasons discussed below, Bhargava fails to disclose (or suggest) all features of the claimed invention.

5. The claimed invention is drawn to a superconductive article comprising a substrate tape and a superconductive layer. The superconductive layer notably includes a plurality of superconductive films of the same material, the films being in direct contact with each other. As described in the present specification, the films are formed by a metalorganic chemical vapor deposition (MOCVD) process, in which metalorganic precursors are reacted with each other in a deposition chamber, the reaction product forming a superconductive material that deposits on the substrate tape. As described in the present specification, pages 23+ in connection with FIGs. 1-4b, the substrate tape is translated through an MOCVD system containing multiple compartments arranged in series, each defining a deposition zone (see Zones A-E). Each zone has associated unique control parameters as described in Tables 1-5. As the substrate translates through the MOCVD system, the substrate tape experiences multiple deposition events, each deposition event corresponding to each zone, thereby forming an identifiable, discrete superconducting film. That is, by passage of the tape through a zone, the zone forms as-deposited superconductive material in the form of a film.

Attached hereto is an SEM micrograph showing a superconductive layer produced by coating of 3 three superconductive films corresponding to YBCO1, YBCO2, and YBCO3. Analysis shows that the individual films are identifiable and are separated by each other by boundary regions corresponding to the arrows shown on the attachment.

6. In contrast, Bhargava is drawn to a solution/sol-based process flow in which the material deposited on the substrate is a sol, corresponding to an organic *precursor* of the superconductive material. In sol-based processing, given the rheology of the sol, it is necessary to form a first precursor layer, followed by drying and subsequent deposition of a second precursor layer. Sol deposition followed by drying is repeated until the desired thickness of a precursor of a superconductive layer is deposited. Upon achievement of the desired thickness, the entire layer is heated, generally in an oxygen-containing environment to convert the precursor material into a superconductor oxide material.

At no time during the process flow of Bhargava are multiple superconductive films formed on top of each other; rather, multiple *precursor* films formed. Upon subsequent heat treatment and conversion of the precursor films, the films form a single, unitary layer having no

identifiable film boundaries. That is, due to the process flow associated with sol-based processing, identifiable superconductive films are not formed. This is due to the fact that conversion of the deposited precursor layers takes place in a single heat treatment step, while the MOCVD process according to embodiments of the present invention result in as-deposited superconductive films formed via multiple, discrete depositions steps corresponding to respective zones.

Attached is an SEM cross-section of a sol-based film formed by metalorganic deposition (MOD) that was formed by multiple deposition and drying process steps to build-up the layer thickness shown in the micrograph, then converted by heat treatment. The SEM cross-section is representative of the teachings of Bhargava. As shown, the superconductive layer is a unitary structure composed of a single, monolithic mass of material entirely devoid of individual films.

7. In summary, it is quite clear that sol-based processing having intermediate drying steps cannot result in an superconductive layer having multiple, identifiable superconductive films.

8. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like, so made, are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

February 21, 2006

Date

Respectfully submitted,



Venkat Selvamanickam

YBCO produced by MOCVD in 3 passes



Arrows show the boundaries between the 3 layers.

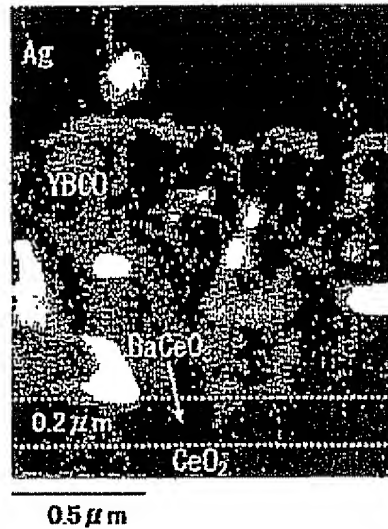


Fig. 2. TEM photograph of the cross section in the four times coated film with 1.1 μm thick.

thickness exists at the interface between the YBCO and CeO_2 . The reason for the degradation of J_c in the thin film could be explained by the existence of the BaCeO_3 layer.

4. Long tape processing

When we applied the TFA process to the long tape production, the design of the gas flow system becomes a key technology. Fig. 3 shows the position dependence of the J_c in the transverse and parallel gas flow to the long direction of the tape. According to this result, a homogeneous tape can be fabricated by the transverse gas flow system. On the other hand, the J_c values in the parallel gas flow system drastically decrease from the windward to the leeward. In order to understand this tendency, we investigated the growth rate of YBCO phase. Fig. 4 shows the position dependence of the growth rate in the parallel gas flow system. From this result, the growth rate of YBCO decreased with increasing the tape length. Therefore, the YBCO reaction in the parallel gas flow

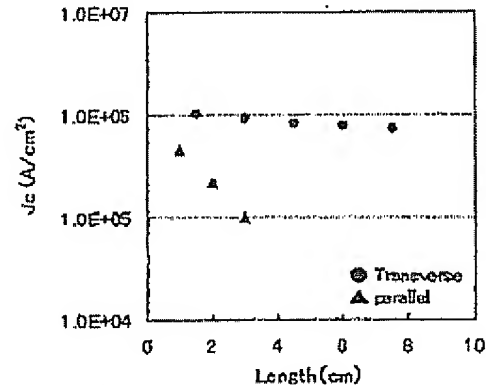


Fig. 3. Position dependence of the J_c in the transverse and parallel gas flow to the long direction of the tape.

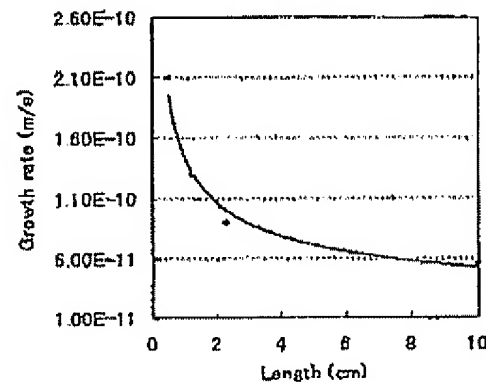


Fig. 4. Position dependence of the growth rate in the parallel gas flow system.

system may not be completed within the same annealing time. The reason for this phenomenon could be explained by the calculation of two-dimensional analysis for the mass transfer of H_2O and HF gases in the gas boundary layer ahead of the surface of the precursor. The details will be published in another report [18]. Concerning the long tape processing, the above tendency should be an important problem to be solved a reasonable production rate in the continuous system. Therefore, in order to obtain a high production rate, the

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DECLARATION UNDER 37 C.F.R. §1.132

Sir, I hereby declare and state:

1. I am a joint inventor of the subject matter presently claimed in the above-identified patent application.
2. I received my doctorate degree in Materials Engineering from the University of Houston in Houston, TX.
3. I have been employed by IGC/SuperPower, Inc. since 1994, wherein I have been mainly engaged in research and development of superconducting materials, superconducting conductors, and processes for forming same.
4. I have reviewed the Office Action dated October 18, 2005, including the positions taken by the PTO with respect to several prior art references. I have also particularly reviewed the subject matter of US 2005/0173679, Mannhart et al. (Mannhart). For the reasons discussed below, Mannhart fails to disclose (or suggest) all features of the claimed invention.

5. The claimed invention is drawn to a superconductive article comprising a substrate tape and a superconductive layer. The superconductive layer notably includes a plurality of individually identifiable superconductive films of the same material, the films being disposed one atop another and atomically bonded to each other free of an intervening bonding layer. As described in the present specification, the films are formed by a metalorganic chemical vapor deposition (MOCVD) process, in which metalorganic precursors are reacted with each other in a deposition chamber, the reaction product forming a superconductive material that deposits on the substrate tape. As described in the present specification, pages 23+ in connection with FIGs. 1-4b, the substrate tape is translated through an MOCVD system containing multiple compartments arranged in series, each defining a deposition zone (see Zones A-E). Each zone has associated unique control parameters as described in Tables 1-5. As the substrate translates through the MOCVD system, the substrate tape experiences multiple deposition events, each deposition event corresponding to each zone, thereby forming an identifiable, discrete superconducting film. That is, by passage of the tape through a zone, the zone forms as-deposited superconductive material in the form of a film.

MOCVD deposition results in epitaxial growth of the depositing film. As such, the microstructure of the preceding film, i.e. crystal grain orientation, is continued and duplicated in the depositing film. That is, the depositing film is atomically bonded to the preceding film. More specifically, the atoms of the depositing film atomically bond to the atoms of the preceding film in well defined crystallographically defined manner as a result of the sequential MOCVD process flow. While a telltale interfacial boundary remains between films, the films are nevertheless necessarily atomically bonded to each other. These features can be clearly seen in the attached cross sectional microstructure obtained by Transmission Electron Microscopy (TEM) of a superconductive article prepared by the process disclosed in the present specification and described above. The TEM image was obtained by Dr. Terry Holesinger, a world-renowned expert, at Los Alamos National Laboratory. Dr. Holesinger followed the above-described process to unequivocally demonstrate the nature of the bonding between overlying films. The TEM microstructure clearly shows the interfacial boundaries between the films that are created between each superconductive film. However, dislocations can be seen threading through all the films indicating that the films are crystallographically oriented in the same fashion one atop each

other i.e. they have an epitaxial relationship with each other and are atomically bonded to each other.

6. In contrast, Mannhart is drawn to a process for joining separate superconductive films through physical contact or an intermediate layer, and does not disclose direct, atomic bonding with each other. In one embodiment, Mannhart discloses physically clamping two superconductors together (FIG. 5). In another, Mannhart discloses melting the intermediate layer to fuse the two adjacent superconductive layers. I acknowledge that Mannhart discloses multilayers in paragraph [0041]. However, such general suggestion does not extend to the superconductive layer as claimed, which features multiple films atomically bonded directly to each other. Adding yet additional layers to the embodiments of Mannhart remains reliant on physically bonding (clamping) or use of intermediate layers.

7. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like, so made, are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

August 6, 2007

Date

Respectfully submitted,



Venkat Selvamanickam

XI. RELATED PROCEEDINGS APPENDIX (37 C.F.R. § 41.37(c)(1)(x))

Appellants, Appellants' legal representatives, and Assignee are aware of no decisions that have been rendered by a court or the Board.